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Hu et al.

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(54) **NEAR-DUPLICATE FILTERING IN SEARCH ENGINE RESULT PAGE OF AN ONLINE SHOPPING SYSTEM**

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G06F 17/30 (2006.01)
G06Q 30/06 (2012.01)

(52) **U.S. Cl.**
CPC ***G06Q 30/0635*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,615,209 B1 9/2003 Gomes et al.
7,016,864 B1 3/2006 Notz et al.
7,197,479 B1 3/2007 Franciscus de Heer et al.
7,681,120 B2 3/2010 Kikuchi
7,725,363 B2 5/2010 Speers et al.
7,734,569 B2 * 6/2010 Martin et al. 707/999.005
7,966,291 B1 * 6/2011 Petrovic et al. 707/641
8,005,842 B1 * 8/2011 Pasca et al. 707/741

(Continued)

FOREIGN PATENT DOCUMENTS

CN 102411591 A 4/2012
CN 102663058 A 9/2012

(Continued)

OTHER PUBLICATIONS

iTunes Preview—Moodboard by A Tiny Tribe, Inc.—Description of application available for iPad-downloaded Aug. 16, 2011, http://itunes.apple.com/us/app/moodboard-pro/id35893506?mt=8, pp. 1-2.

(Continued)

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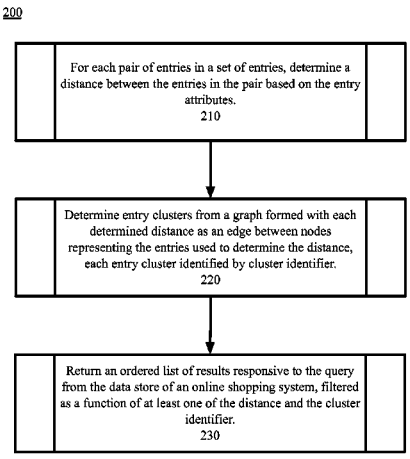
(57) **ABSTRACT**

Reducing near-duplicate entries in online shopping system search results. For each pair of entries in a set of entries, each entry characterizing a product in a data store of an online shopping system and each entry characterized by a set of attributes, determining a distance between the entries in the pair based on the attributes. Determining entry clusters from a graph formed with each determined distance as an edge between nodes representing the entries used to determine the distance, each entry cluster identified by cluster identifier. Returning an ordered list of results responsive to the query from the data store of an online shopping system, filtered as a function of at least one of the distance and the cluster identifier.

18 Claims, 10 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

8,214,335	B2	7/2012	Hamilton, II et al.	
2001/0034740	A1	10/2001	Kerne	
2004/0113945	A1	6/2004	Park et al.	
2004/0143600	A1	7/2004	Musgrove et al.	
2005/0131770	A1*	6/2005	Agrawal	G06Q 30/0201 705/7.29
2005/0198354	A1	9/2005	Holloway, Jr.	
2005/0246240	A1	11/2005	Padilla	
2006/0011720	A1	1/2006	Call	
2006/0200759	A1	9/2006	Agrawala et al.	
2007/0118441	A1	5/2007	Chatwani et al.	
2007/0143235	A1*	6/2007	Kummamuru et al.	706/15
2008/0126221	A1	5/2008	Swanson	
2008/0193048	A1	8/2008	Sun et al.	
2008/0228545	A1	9/2008	Jiang	
2008/0243816	A1*	10/2008	Chan et al.	707/5
2008/0306966	A1	12/2008	Culot et al.	
2009/0106671	A1	4/2009	Olson et al.	
2009/0132943	A1	5/2009	Minsky et al.	
2010/0008538	A1	1/2010	Rodriguez et al.	
2010/0094849	A1	4/2010	Rose et al.	
2010/0169331	A1*	7/2010	Karidi et al.	707/754
2010/0169340	A1*	7/2010	Kenedy et al.	707/758
2010/0199227	A1	8/2010	Xiao et al.	
2011/0137989	A1	6/2011	Kiciman et al.	
2012/0078871	A1	3/2012	Pugh et al.	
2012/0232914	A1	9/2012	Chodavarapu et al.	
2013/0124368	A1	5/2013	Zhang et al.	

FOREIGN PATENT DOCUMENTS

JP	2002163559	A	6/2002
JP	2003337909	A	11/2003

OTHER PUBLICATIONS

Moodboard Example "Kingdom Interiors", http://www.kingdominteriors.co.uk/moodboard downloaded Aug. 16, 2011, pp. 1-5.

Olioboard—"About Oliboard", http://olioboard.com/pages/about_ accessed Aug. 16, 2011, pp. 1-7.

Olioboard—Frequently Asked Questions, http://olioboard.com/pages/faq—accessed Aug. 16, 2011, pp. 1-13.

Passikoff, R., The Keyhole: Peeking at 21st Century Brands—The Big Book of Dreams Goes Online, http://brandkeys.blogspot.com/2009_11_01_archive.html, pp. 1-7, Nov. 19, 2009.

Pohlman, J. G., Office Action issued in copending related U.S. Appl. No. 13/209,566, filed Aug. 15, 2011, pp. 1-30, Dec. 4, 2013.

Pohlman, J. G., Office Action issued in copending related U.S. Appl. No. 13/209,566, filed Aug. 15, 2011, pp. 1-17, Jan. 31, 2013.

Alrobai, et al., "Investigating the Usability of e-Catalogues Systems: Modified Heuristics vs. User Testing", Journal of Technology Research; downloaded from http://www.aabri.com/manuscripts/121300.pdf, Dec. 29, 2015, 1-29.

Haq, "Office Action issued in co-pending U.S. Appl. No. 13/209,562, filed Aug. 15, 2011", Jan. 5, 2015, 1-8.

Nguyen, "Office Action issued in co-pending U.S. Appl. No. 13/205,154, filed Aug. 8, 2011", Dec. 19, 2014, 1-7.

Segev, et al., "Electronic Catalogs: A Technology Overview and Survey Results", ACM 0-89791-812-6/95/11, 1995, 11-18.

Haq, "Office Action issued in copending U.S. Appl. No. 13/209,562, filed Aug. 15, 2011", Sep. 10, 2014, 1-7.

Nguyen, "Office Action issued in copending U.S. Appl. No. 13/205,154, filed Aug. 8, 2011", Jun. 13, 2014, 1-12.

U.S. Appl. No. 13/209,566 to Kibera et al. filed Aug. 15, 2011.

U.S. Appl. No. 13/205,154 to Carlson et al. filed Aug. 8, 2011.

U.S. Appl. No. 13/717,524 to Compton et al. filed Dec. 17, 2012.

Fan, Y., International Search Report and Written Opinion issued in International Application No. PCT/CN2013/080631, May 12, 2014.

Haq, N., Office Action issued in copending U.S. Appl. No. 13/209,562, filed Aug. 15, 2011, pp. 1-15, Mar. 6, 2014.

Gallup, "Office Action issued in copending U.S. Appl. No. 13/717,524, filed Dec. 17, 2012", Apr. 23, 2015, 1-20.

Nguyen, "Office Action issued in copending U.S. Appl. No. 13/205,154, filed Aug. 8, 2011", Apr. 9, 2015, 1-10.

Sundar, "Office Action issued in copending U.S. Appl. No. 13/209,566, filed Aug. 15, 2011", Nov. 18, 2015, 1-30.

* cited by examiner

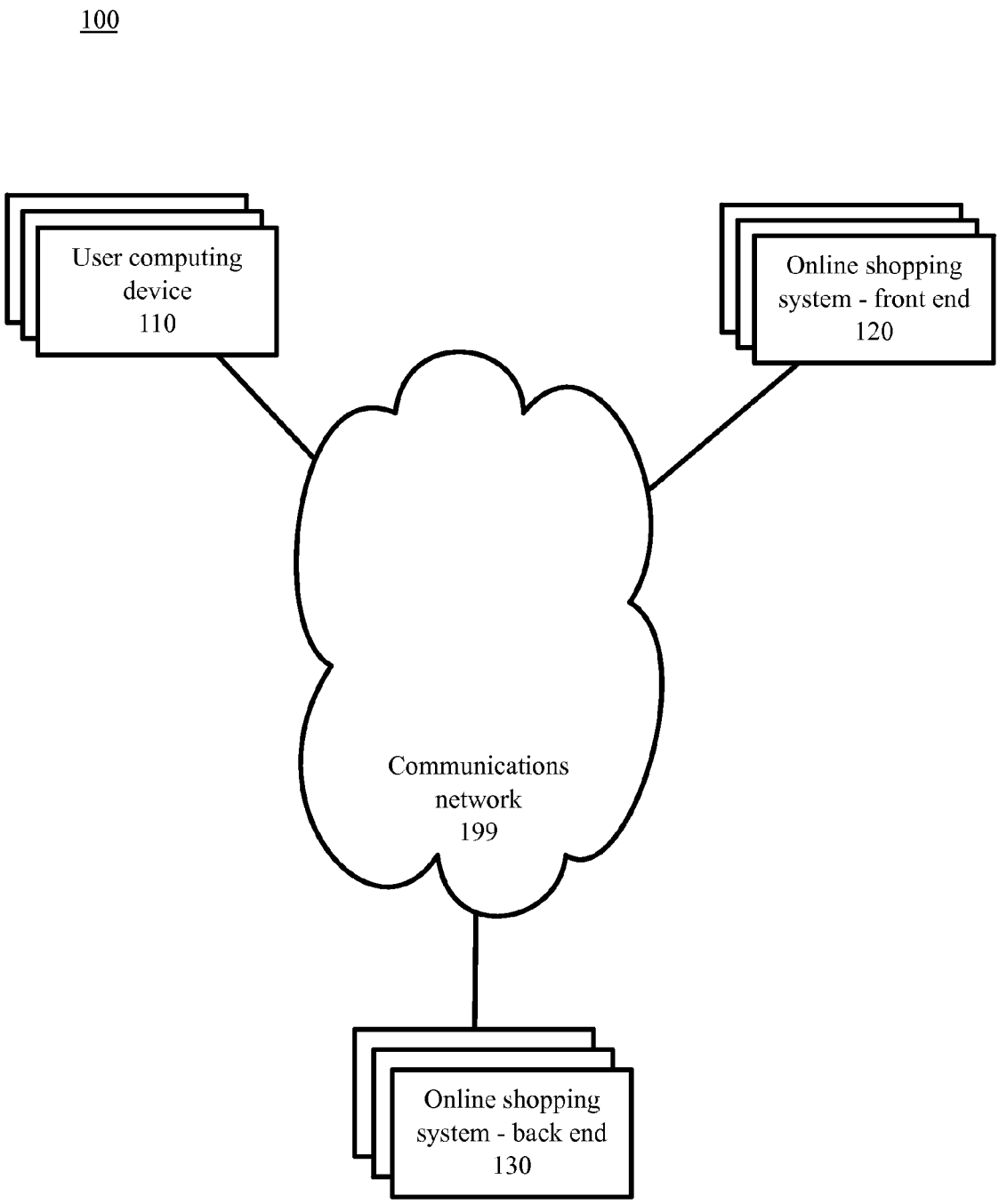

100
User computing device 110
Online shopping system - front end 120
Communications network 199
Online shopping system - back end 130

FIG. 1

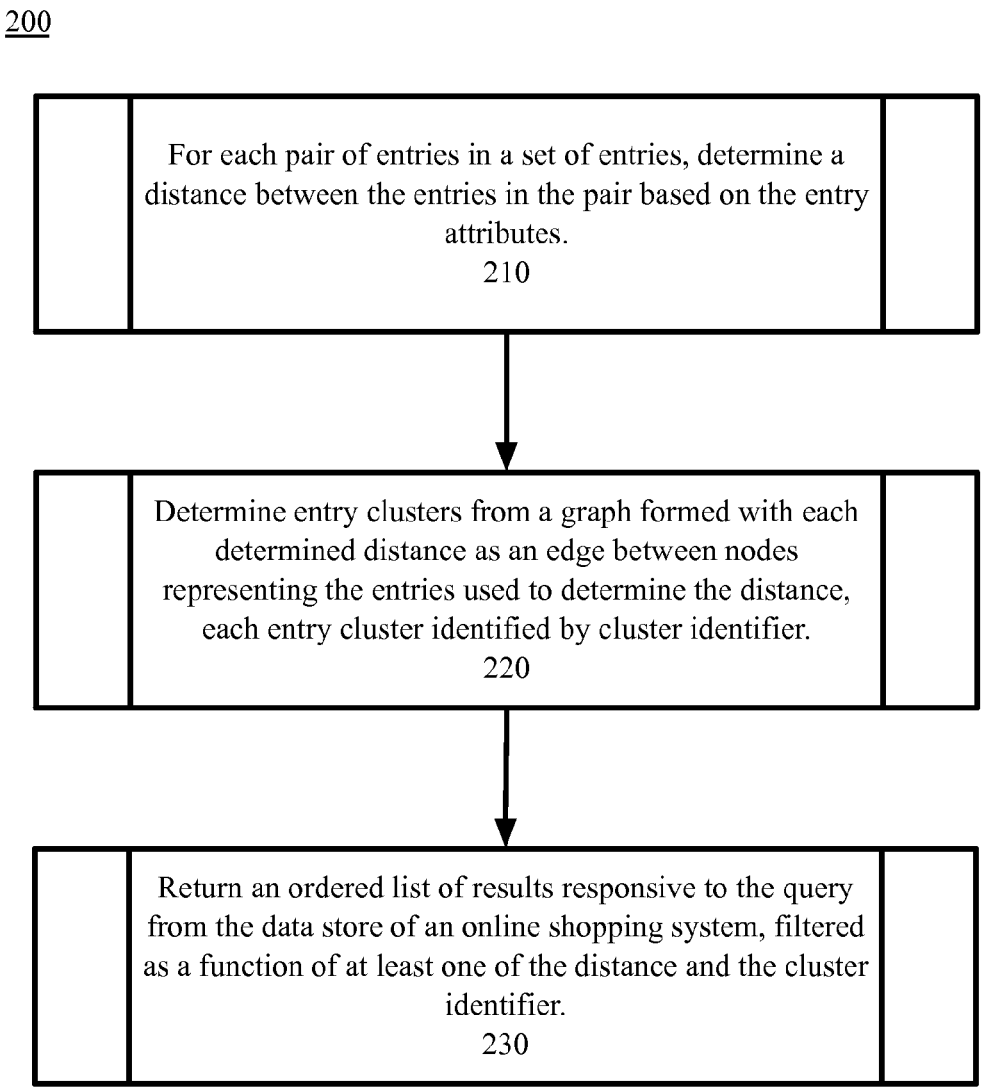

200
For each pair of entries in a set of entries, determine a distance between the entries in the pair based on the entry attributes.
210
Determine entry clusters from a graph formed with each determined distance as an edge between nodes representing the entries used to determine the distance, each entry cluster identified by cluster identifier.
220
Return an ordered list of results responsive to the query from the data store of an online shopping system, filtered as a function of at least one of the distance and the cluster identifier.
230

FIG. 2

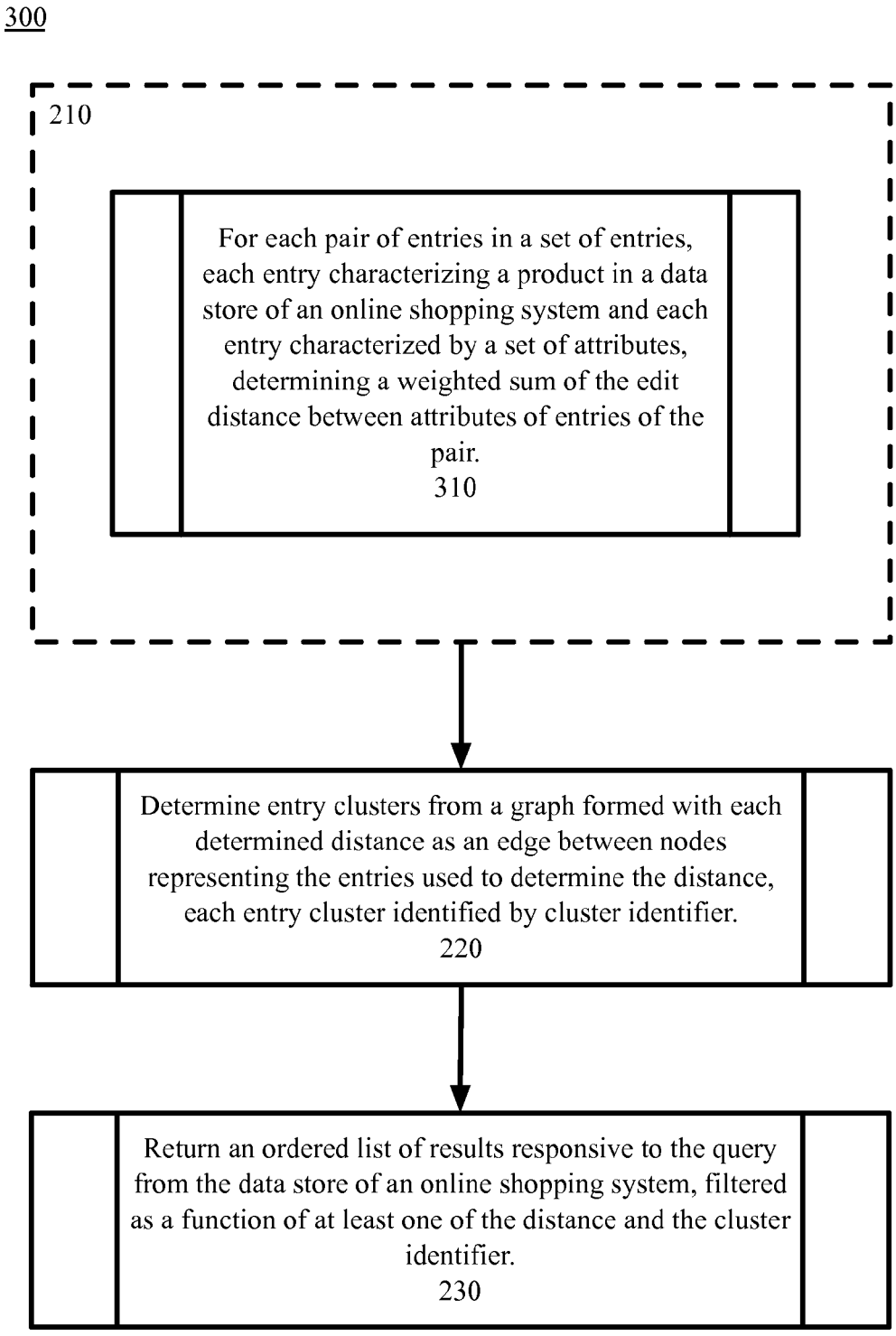

300
210
For each pair of entries in a set of entries, each entry characterizing a product in a data store of an online shopping system and each entry characterized by a set of attributes, determining a weighted sum of the edit distance between attributes of entries of the pair.
310
Determine entry clusters from a graph formed with each determined distance as an edge between nodes representing the entries used to determine the distance, each entry cluster identified by cluster identifier.
220
Return an ordered list of results responsive to the query from the data store of an online shopping system, filtered as a function of at least one of the distance and the cluster identifier.
230

FIG. 3

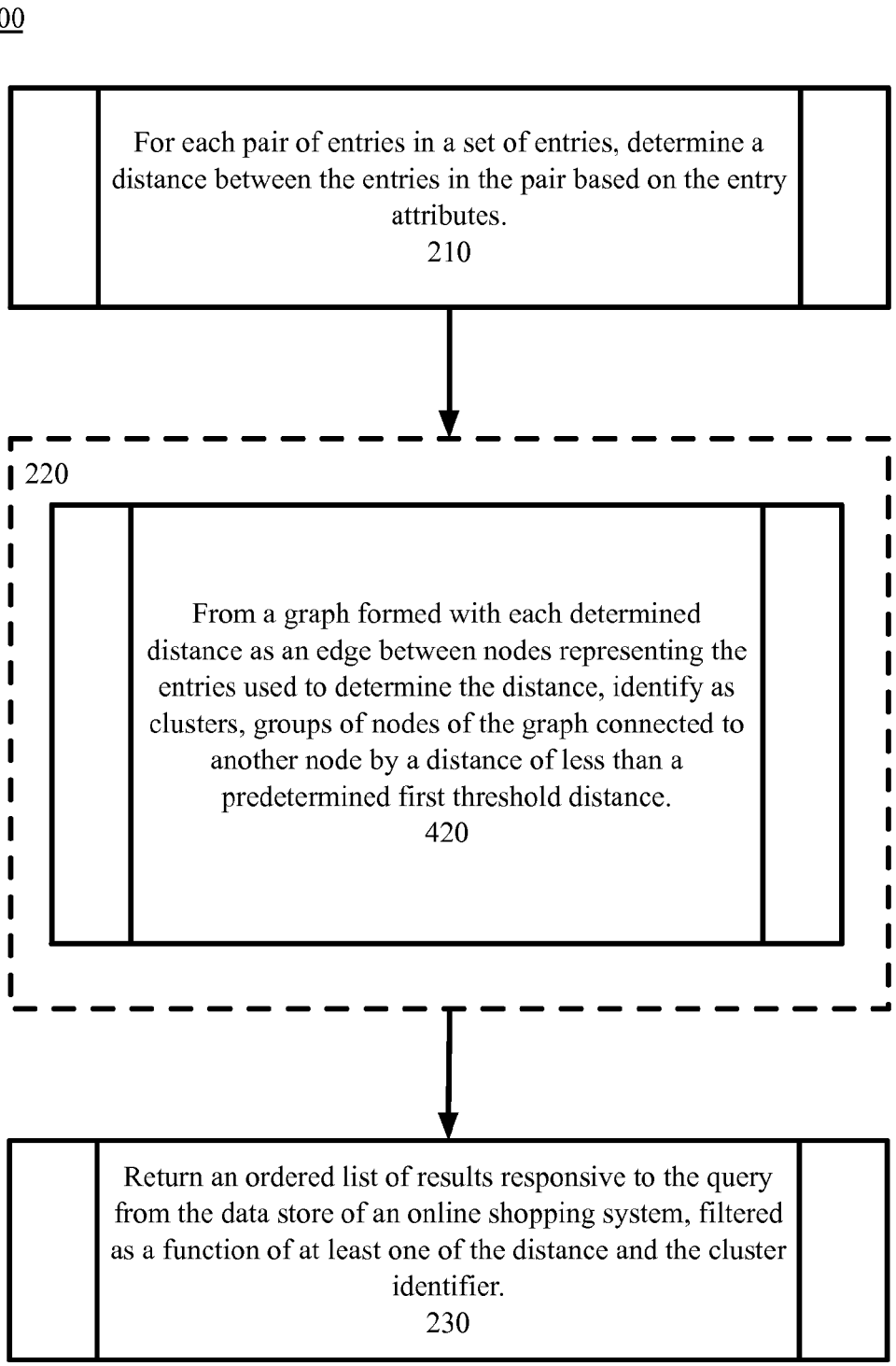

400
For each pair of entries in a set of entries, determine a distance between the entries in the pair based on the entry attributes.
210
220
From a graph formed with each determined distance as an edge between nodes representing the entries used to determine the distance, identify as clusters, groups of nodes of the graph connected to another node by a distance of less than a predetermined first threshold distance.
420
Return an ordered list of results responsive to the query from the data store of an online shopping system, filtered as a function of at least one of the distance and the cluster identifier.
230

FIG. 4

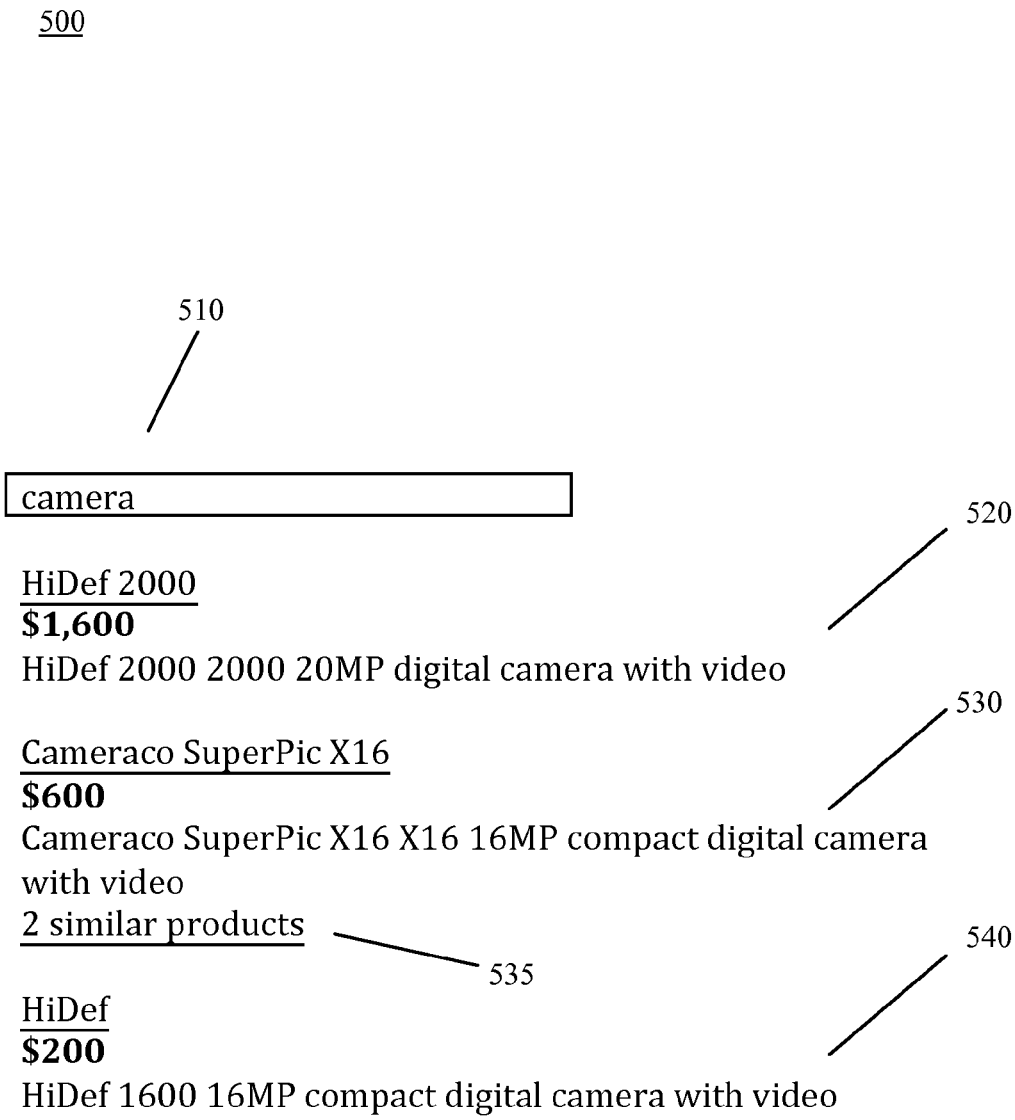

500
510
camera
520
HiDef 2000
$1,600
HiDef 2000 2000 20MP digital camera with video
530
Cameraco SuperPic X16
$600
Cameraco SuperPic X16 X16 16MP compact digital camera with video
2 similar products
535
540
HiDef
$200
HiDef 1600 16MP compact digital camera with video

FIG. 5

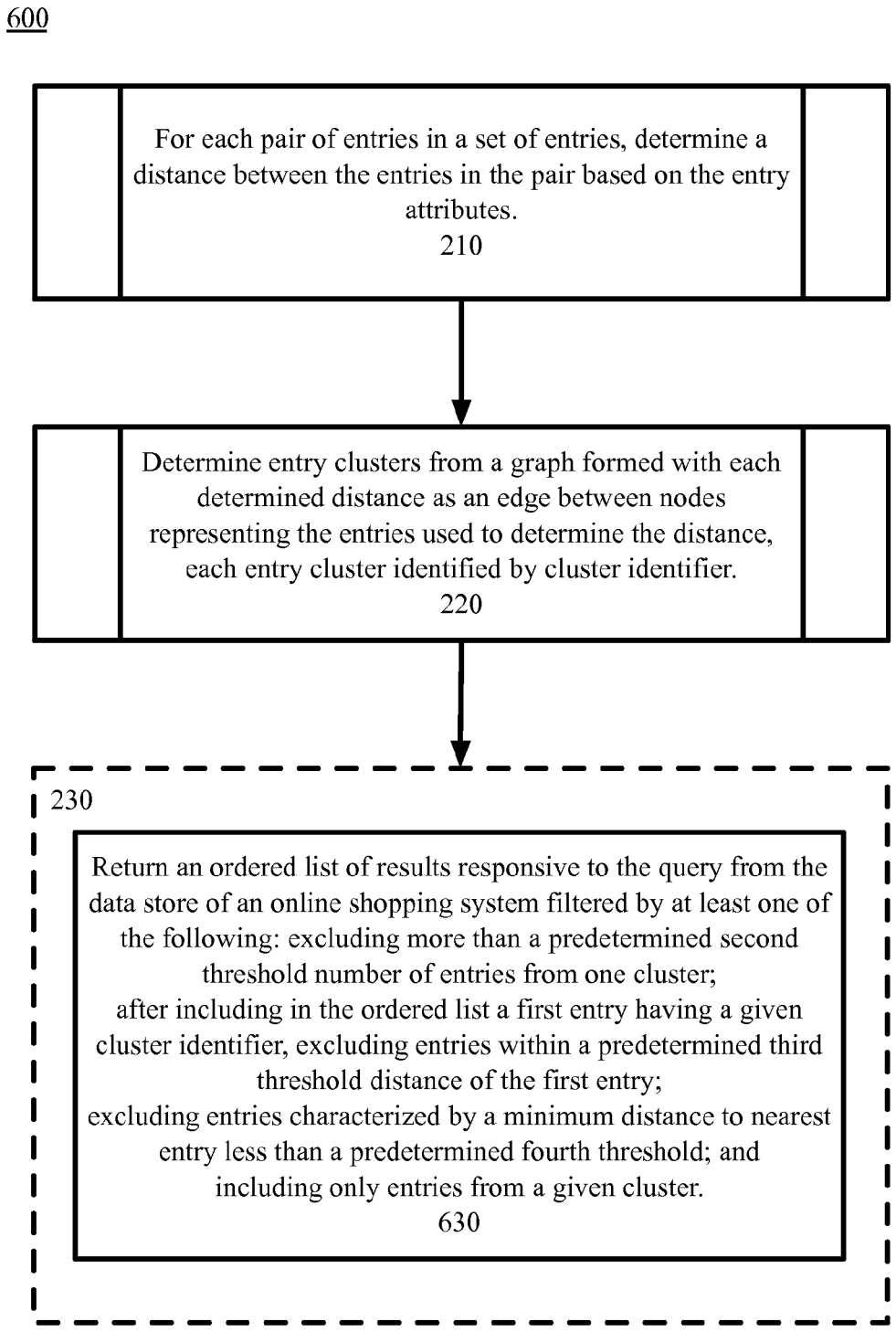

600
For each pair of entries in a set of entries, determine a distance between the entries in the pair based on the entry attributes.
210
Determine entry clusters from a graph formed with each determined distance as an edge between nodes representing the entries used to determine the distance, each entry cluster identified by cluster identifier.
220
230
Return an ordered list of results responsive to the query from the data store of an online shopping system filtered by at least one of the following: excluding more than a predetermined second threshold number of entries from one cluster;
after including in the ordered list a first entry having a given cluster identifier, excluding entries within a predetermined third threshold distance of the first entry;
excluding entries characterized by a minimum distance to nearest entry less than a predetermined fourth threshold; and
including only entries from a given cluster.
630

FIG. 6

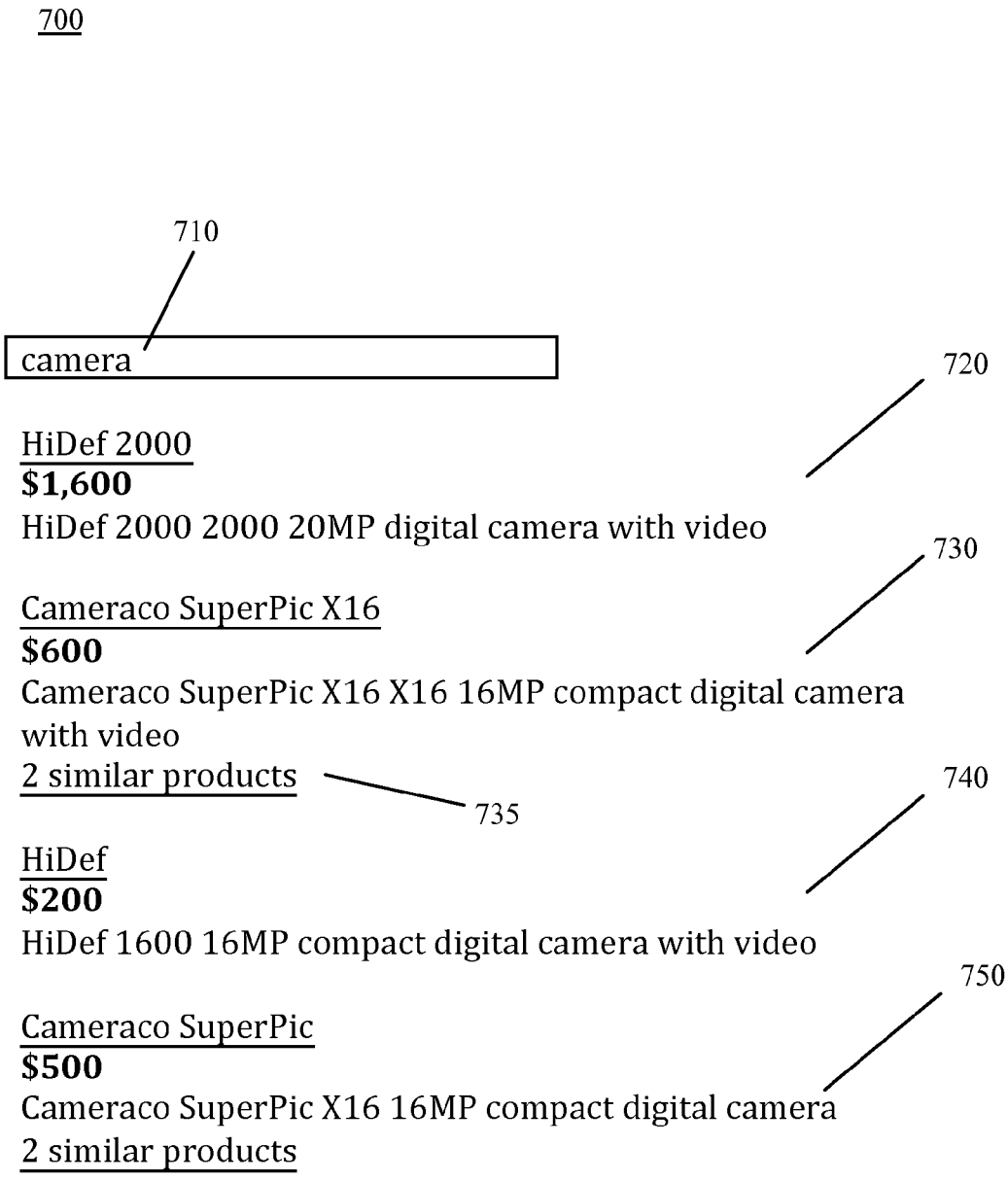

700
710
camera
720
HiDef 2000
$1,600
HiDef 2000 2000 20MP digital camera with video
730
Cameraco SuperPic X16
$600
Cameraco SuperPic X16 X16 16MP compact digital camera with video
2 similar products
735
740
HiDef
$200
HiDef 1600 16MP compact digital camera with video
750
Cameraco SuperPic
$500
Cameraco SuperPic X16 16MP compact digital camera
2 similar products

FIG. 7

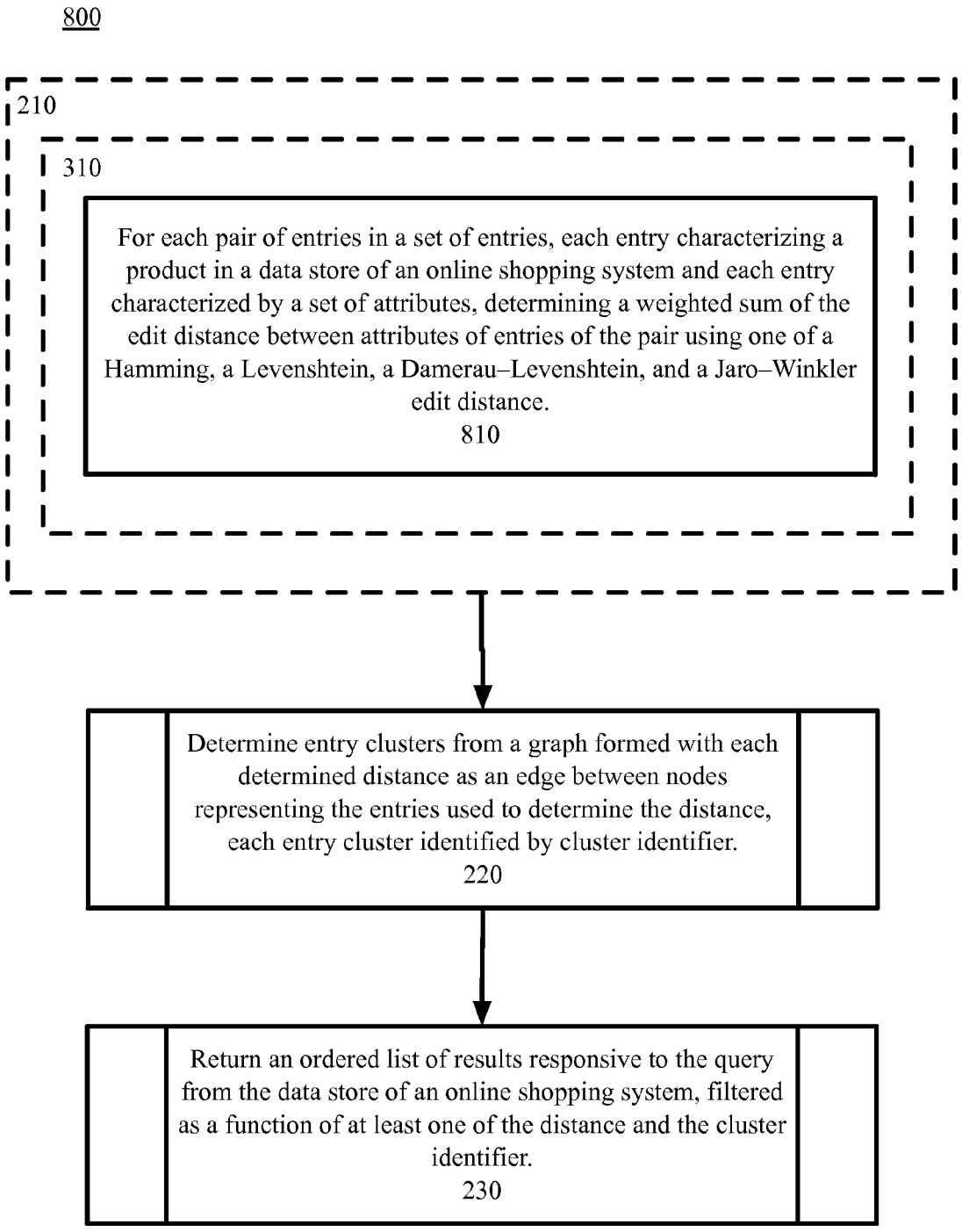

800
210
310
For each pair of entries in a set of entries, each entry characterizing a product in a data store of an online shopping system and each entry characterized by a set of attributes, determining a weighted sum of the edit distance between attributes of entries of the pair using one of a Hamming, a Levenshtein, a Damerau–Levenshtein, and a Jaro–Winkler edit distance.
810
Determine entry clusters from a graph formed with each determined distance as an edge between nodes representing the entries used to determine the distance, each entry cluster identified by cluster identifier.
220
Return an ordered list of results responsive to the query from the data store of an online shopping system, filtered as a function of at least one of the distance and the cluster identifier.
230

FIG. 8

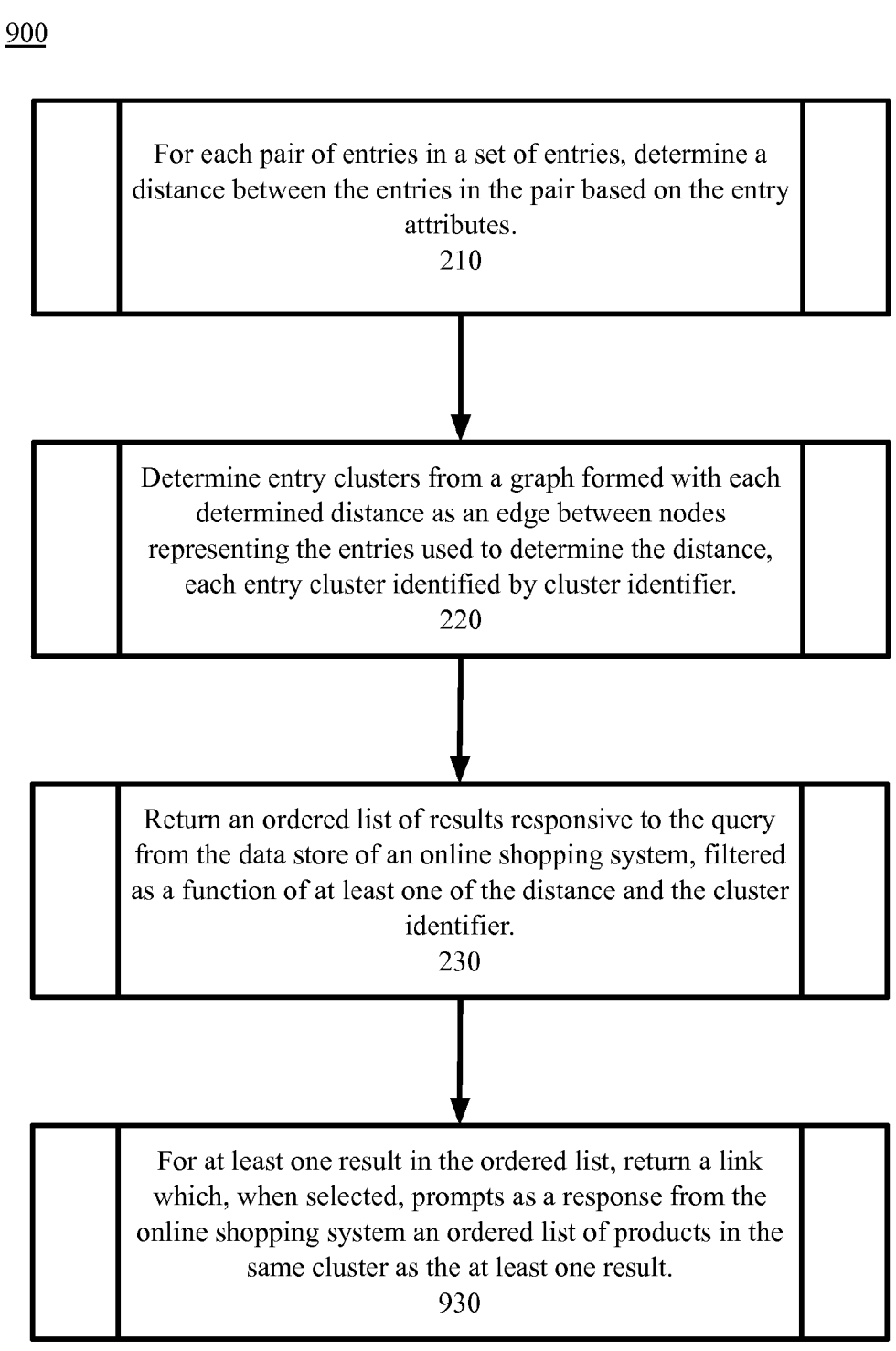

900
For each pair of entries in a set of entries, determine a distance between the entries in the pair based on the entry attributes.
210
Determine entry clusters from a graph formed with each determined distance as an edge between nodes representing the entries used to determine the distance, each entry cluster identified by cluster identifier.
220
Return an ordered list of results responsive to the query from the data store of an online shopping system, filtered as a function of at least one of the distance and the cluster identifier.
230
For at least one result in the ordered list, return a link which, when selected, prompts as a response from the online shopping system an ordered list of products in the same cluster as the at least one result.
930

FIG. 9

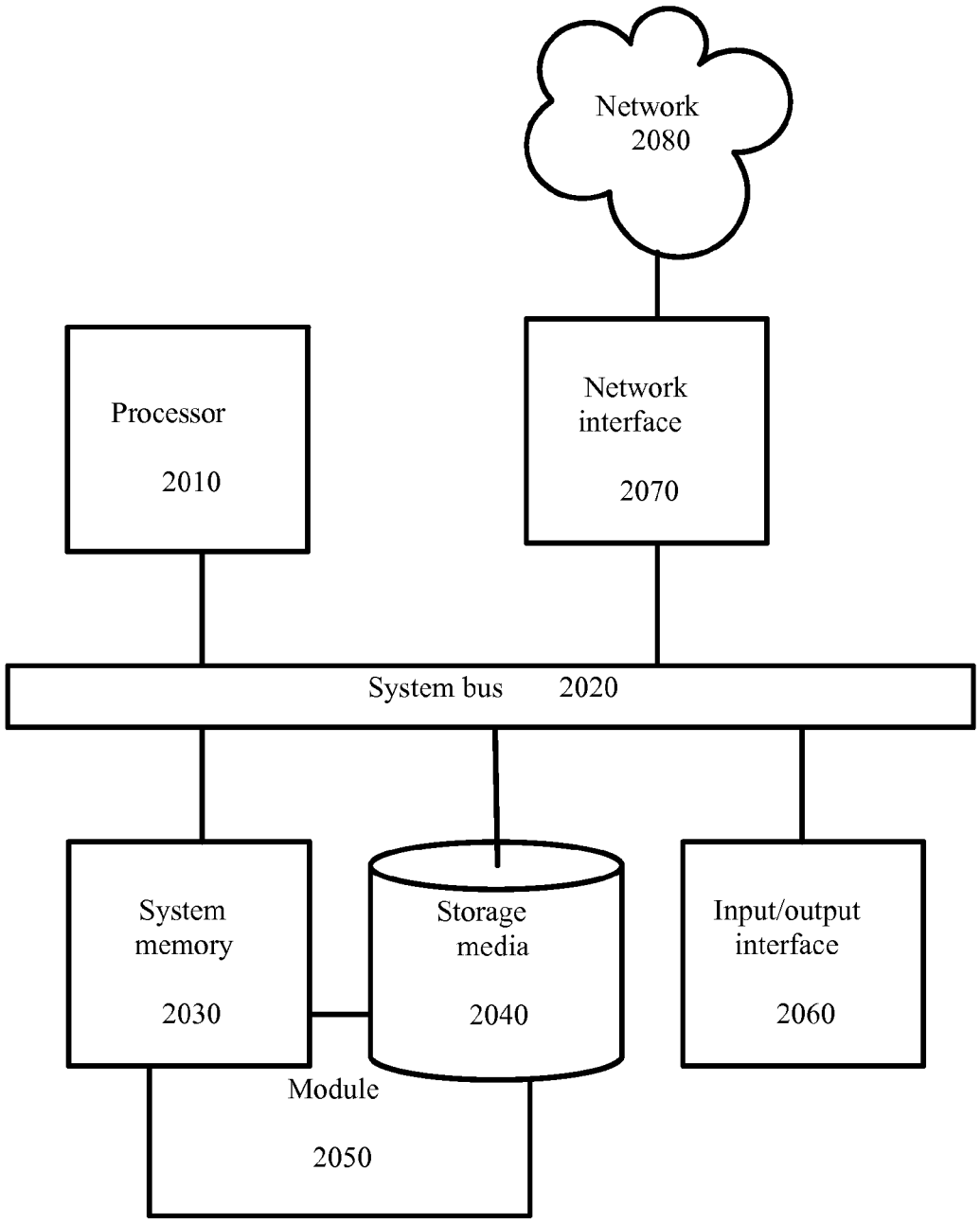

2000
Network
2080
Processor
2010
Network
interface
2070
System bus 2020
System
memory
2030
Storage
media
2040
Input/output
interface
2060
Module
2050

FIG. 10

NEAR-DUPLICATE FILTERING IN SEARCH ENGINE RESULT PAGE OF AN ONLINE SHOPPING SYSTEM

RELATED APPLICATIONS

This application claims priority to and is a continuation of International Patent Application No. PCT/CN2013/080631, filed Aug. 1, 2013 and entitled "Near-Duplicate Filtering in Search Engine Result Page of an Online Shopping System." The entire contents of the above-identified priority application are hereby fully incorporated herein by reference.

FIELD OF THE TECHNOLOGY

The disclosed technology relates to filtering near-duplicate results from search engine results pages. Example embodiments relate to filtering near-duplicate products from search results of an online shopping system.

BACKGROUND

A Search Engine Results Page (SERP) is a list, typically of information about web pages, from a search engine in response to a query. Each item in the list may include a title (typically hyperlinked to a web page responsive to the query), a reference to the full version of the listed web page, and a short description from the listed web page corresponding to elements of the query (also known as a "snippet").

In online shopping, a consumer may search for, browse, and purchase goods and services over the Internet, typically by querying an online shopping database through an Internet browser. Each item in an online shopping SERP normally represents a product responsive to query. A consumer may find a product of interest by visiting the website of the retailer directly or by searching among alternative vendors using a shopping search engine.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of an architecture for example embodiments of the technology disclosed herein.

FIG. **2** is a diagram depicting method for reducing near-duplicate entries in online shopping system search results, in accordance with certain example embodiments.

FIG. **3** is a diagram depicting method for reducing near-duplicate entries in online shopping system search results, in accordance with certain example embodiments.

FIG. **4** is a diagram depicting method for reducing near-duplicate entries in online shopping system search results, in accordance with certain example embodiments.

FIG. **5** is a search engine results page, in accordance with certain example embodiments.

FIG. **6** is a diagram depicting method for reducing near-duplicate entries in online shopping system search results, in accordance with certain example embodiments.

FIG. **7** is a search engine results page, in accordance with certain example embodiments.

FIG. **8** is a diagram depicting method for reducing near-duplicate entries in online shopping system search results, in accordance with certain example embodiments.

FIG. **9** is a diagram depicting method for reducing near-duplicate entries in online shopping system search results, in accordance with certain example embodiments.

FIG. **10** is a block diagram depicting a computing machine and a module, in accordance with certain example embodiments.

SUMMARY

The technology includes methods, computer program products, and systems for reducing near-duplicate entries in online shopping system search results. In some embodiments, for each pair of entries in a set of entries, each entry characterizing a product in a data store of an online shopping system and each entry characterized by a set of attributes, embodiments of the technology can determine a distance between the entries in the pair based on the attributes. Entry clusters can be determined from a graph formed with each distance as an edge between nodes representing the entries used to determine the distance. Each such entry cluster can be identified by a cluster identifier. An ordered list of results responsive to the query can be returned from the data store of an online shopping system, and filtered as a function of at least one of the distance and the cluster identifier.

In some embodiments, determining a distance between the entries in the pair based on the attributes comprises determining a weighted sum of the edit distance between attributes of entries of the pair. In some such embodiments, the edit distance is one of: a Hamming distance, a Levenshtein distance, a Damerau-Levenshtein distance, and a Jaro-Winkler distance.

In some embodiments, the set of entries comprises a set of entries of a single vendor of the online shopping system.

In some embodiments, determining entry clusters comprises identifying as clusters, groups of nodes of the graph connected to another node by a distance of less than a predetermined first threshold distance. In some such embodiments, the distance is normalized on an interval from 0 to 1, and the predetermined threshold distance is approximately 0.05.

In some embodiments, the function of at least one of the distance and the cluster identifier is at least one of: excluding more than a predetermined second threshold number of entries from one cluster; after including in the ordered list a first entry having a given cluster identifier, excluding entries within a predetermined third threshold distance of the first entry; excluding entries characterized by a minimum distance to nearest entry less than a predetermined fourth threshold; and including only entries from a given cluster.

In some embodiments the technology can, for at least one result in the ordered list, return a link which, when selected, prompts as a response from the online shopping system an ordered list of products in the same cluster as the at least one result.

These and other aspects, objects, features, and advantages of the example embodiments will become apparent to those having ordinary skill in the art upon consideration of the following detailed description of illustrated example embodiments.

DETAILED DESCRIPTION

Overview

In the data store of product information used in a typical online shopping system, there may be multiple entries with identical or only slightly different product attributes. For example, <model>, <category>, <description>, and <image> may be similar, if not identical, across the entries for two or more products represented in the data store. Such nearly duplicate ("near-duplicate") entries can dominate search results in an online shopping system, reducing the diversity generally desired by consumers. For example, in a shopping search engine comprising a data store of product information from a plurality of vendors, one vendor's near-duplicates can

dominate a SERP, especially the first page of a multipage SERP. In some online shopping systems, over 25% of the entries in the product information data store can be near duplicate to at least one other entry.

While subsequent scenarios and examples herein are in the context of a shopping search engine comprising a data store of product information from a plurality of vendors, the principles of the technology are applicable to online shopping systems generally.

It is not apparent that reducing near duplicates across an entire online shopping system will increase the diversity of SERP listings—especially from the point of view of a customer, who may desire to see the same, or near duplicate, products offered on different terms from a variety of companies. Embodiments of the present technology can reduce intra-company near duplicate entries in an online shopping system SERP, thereby increasing the diversity of vendors represented in an online shopping system SERP.

Turning now to the drawings, in which like numerals represent like (but not necessarily identical) elements throughout the figures, example embodiments of the present technology are described in detail.

Example System Architecture

FIG. **1** is a diagram of an architecture **100** for example embodiments of the technology disclosed herein. As depicted in FIG. **1**, the architecture **100** includes network devices **110**, **120**, and **130**; each of which may be configured to communicate with one another via communications network **199**. In some embodiments, a user associated with a device must install an application and/or make a feature selection to obtain the benefits of the techniques described herein.

Network **199** includes one or more wired or wireless telecommunications means by which network devices may exchange data. For example, the network **199** may include one or more of a local area network (LAN), a wide area network (WAN), an intranet, an Internet, a storage area network (SAN), a personal area network (PAN), a metropolitan area network (MAN), a wireless local area network (WLAN), a virtual private network (VPN), a cellular or other mobile communication network, a BLUETOOTH® wireless technology connection, a near field communication (NFC) connection, any combination thereof, and any other appropriate architecture or system that facilitates the communication of signals, data, and/or messages. Throughout the discussion of example embodiments, it should be understood that the terms "data" and "information" are used interchangeably herein to refer to text, images, audio, video, or any other form of information that can exist in a computer-based environment.

Each network device can include a communication module capable of transmitting and receiving data over the network **199**. For example, each network device can include a server, a desktop computer, a laptop computer, a tablet computer, a television with one or more processors embedded therein and/or coupled thereto, a smart phone, a handheld computer, a personal digital assistant (PDA), or any other wired or wireless processor-driven device. In the example embodiment depicted in FIG. **1**, the network device **110** may be operated by a user, and network devices **120** and **130** may be operated by an online shopping system operator.

The network connections illustrated are example and other means of establishing a communications link between the computers and devices can be used. Moreover, those having ordinary skill in the art having the benefit of the present disclosure will appreciate that the network devices illustrated in FIG. **1** may have any of several other suitable computer system configurations. For example, a user computer device **110** may be embodied as a mobile phone or handheld computer may not include all the components described above.

In the architecture **100** of FIG. **1**, entries in a data store of an online shopping system back end **130** may include entries representing products or services (hereinafter both referred to as "products"). Some of the entries may be near-duplicates of each other. Each entry can be characterized by attributes such as <model> and <description>. A distance between entries, such as an edit distance, can be determined in the online shopping system back end **130**. Such edit distance can be used to identify clusters of near duplicate entries. The distances, for example the minimum distance between any given entry and its closest neighbor, and a cluster identifier can be used (individually or in combination) by the online shopping system front end **120** to reduce the number of near-duplicate entries present in search results that are presented via the user computing device **110** (typically in response to a query from the user computing device **110**).

Example Processes

The example methods illustrated in the following figures are described hereinafter with respect to the components of the example operating environment **100**. The example methods may also be performed with other systems and in other environments.

Referring to FIG. **2**, example processes **200** for filtering near-duplicates from online shopping system search results are illustrated. In such processes, products offered for sale in an online shopping system can be represented by entries in a data store of the online shopping system. Each entry can be characterized by a set of entry attributes. For example, a camera can be represented by a first entry that includes <name> with the string "Cameraco SuperPic,"<model> with the string "X40," and <description> with the string "16MP compact digital camera." Additional example entries are identified in TABLE 1. For each pair of entries in a set of entries in the online shopping system data store, embodiments of the present technology can determine a distance between the entries in the pair based on the entry attributes—Block **210**.

TABLE 1

Index #	Name	Model	Description	Importance Score
1	Cameraco SuperPic	X16	16 MP compact digital camera	87
2	Cameraco SuperPic X16	X16	16 MP compact digital camera with video	123
3	HiDef	1600	16 MP compact digital camera with video	112
4	Cameraco	SuperPic X16	16 MP compact digital camera with video	96
5	HiDef 2000	2000	20 MP digital camera with video	140

For example, counting words unique to one of entry #1 or entry #2 results in a distance of two (2) words, i.e., "with" and "video." Counting words unique to one of entry #1 and entry #3 results in a distance of seven (7) words, i.e., "Cameraco," "SuperPic," "X16," "HiDef," "1600," "with," and "video." TABLE 2 lists the pairwise distances between pairs by index number determined in the same fashion.

TABLE 2

Pair by Index #	Distance (words)
(1, 2)	2
(1, 3)	7
(1, 4)	2
(1, 5)	11
(2, 3)	5
(2, 4)	0
(2, 5)	8
(3, 4)	5
(3, 5)	4
(4, 5)	7

In general, a string metric can be used to determine distance. A string metric is a metric that measures similarity between two strings for approximate string matching or comparison and in fuzzy string searching.

Referring to FIG. **3**, and continuing to refer to prior figures for context, processes **300** for filtering near duplicates from online shopping system search results are illustrated are illustrated. Block **220** and Block **230** are described elsewhere herein. In such processes **300**, determining a distance between entries in a pair of entries can include determining a weighted sum of attributes of an edit distance (a type of spring metric) between attributes of the entries—Block **310**. For example, and one of a Hamming distance, a Levenshtein distance, a Damerau-Levenshtein distance, and a Jaro-Winkler distance can be used.

Returning to FIG. **2**, embodiments of the technology can determine entry clusters from a graph formed with each determined distance as an edge between nodes representing the entries used to determine the distance—Block **220**. Each entry cluster can be identified by cluster identifier.

Referring to FIG. **4**, and continuing to refer to prior figures for context, processes **400** for filtering near duplicates from online shopping system search results are illustrated. Block **210** and Block **230** are described elsewhere herein. In such processes **400**, each determined distance can be interpreted as an edge between nodes representing the entries used to determine the distance. In some embodiments, the technology can identify those groups of nodes connected to another node by a distance of less than a predetermined first threshold distance as a cluster—Block **420**.

Continuing with the example from TABLE 1 and TABLE 2, with a predetermined threshold of three (3) words, entries #1, #2, #4 can be identified as in a single cluster. Entry #3 has distances of 7, 5, 5, and 4 words to entries #1, #2, #4, and #5 respectively; and as such is in its own cluster. Entry #5 has distances of 11, 8, 4, and 7 words to the other entries; and as such also is in its own cluster. Each cluster can take a cluster identifier from one of the entries in the cluster. For example, where the product information data store uses an importance score as an attribute of an entry, some attribute of the entry with the highest importance score can be used as the cluster identifier. For the present example, the Index # of the entry with the highest importance score is used, i.e., the #1, #2, #4 cluster is cluster #2. Entry #3 is cluster #3, and entry #5 is cluster #5. TABLE 3 illustrates assignment of cluster identifier in accordance with the present example. The entries for each product in the data store of the online shopping system can be edited to include the assigned cluster identifier.

TABLE 3

Index #	Name	Model	Description	Importance Score	Cluster ID
1	Cameraco SuperPic	X16	16 MP compact digital camera	87	2
2	Cameraco SuperPic X16	X16	16 MP compact digital camera with video	123	2
3	HiDef	1600	16 MP compact digital camera with video	112	3
4	Cameraco	SuperPic X16	16 MP compact digital camera with video	96	2
5	HiDef 2000	2000	20 MP digital camera with video	140	5

When presented with a query, for example a query from a user computing device **110** to an online shopping system front end **120**, the online shopping system can return entries from its data store (typically maintained by the online shopping system back end **130**) that are responsive to the query. Typically, these results are in an ordered list by some measure of responsiveness of the entry to the query—with the most responsive entries first in the list. As noted above, near duplicate entries may dominate the most responsive results—an undesirable circumstance.

Returning to FIG. **2**, embodiments of the present technology can return, from an online shopping system data store in response to such a query, an ordered list of results that has been filtered by at least one of distance and cluster identifier—Block **230**. Continuing with the present example, the online shopping system is configured to return only one result per cluster. Referring to FIG. **5**, a search engine results page **500** can be returned in response to the query "camera" **510** received at the online shopping system front end **120** from a user computing device **110**, the online shopping system returns a search result page **500** with entries #5 (reference numeral **520**), #2 (reference numeral **530**), and #3 (reference numeral **540**) from TABLE 3 (in that order); and does not return entries #1 and #4 from TABLE 3 (which can be accessed as "similar products" through link **535**).

Referring to FIG. **6**, and continuing to refer to prior figures for context, processes **600** for filtering near duplicates from online shopping system search results are illustrated are illustrated. Block **210** and Block **220** are described elsewhere herein. In such processes **600**, the ordered list of results that has been filtered by at least one of distance and cluster identifier from an online shopping system in response to a query can be filtered various ways including one of the following: excluding more than a predetermined second threshold number of entries from any one cluster; after including in the ordered list a first entry having a given cluster identifier, excluding entries within a predetermined third threshold distance of the first entry; excluding entries characterized by a minimum distance to nearest entry less than a predetermined fourth threshold; and including only entries from a given cluster—Block **630**.

In the example described in connection with FIG. **5**, the predetermined second threshold number of distance is one (1). As a further example, consider the query "camera" as above, a predetermined third threshold distance of one (1) word, and a search engine results page with entries ordered by importance score. Referring to FIG. **7**, under such conditions, a search engine results page **700** can be returned in response to the query "camera" **710** received at the online shopping system front end **120** from a user computing device **110**, the

online shopping system returns a search result page **700** with entries #5 (reference numeral **720**), #2 (reference numeral **730**), and #3 (reference numeral **740**), and #1 (reference numeral **750**) from TABLE 3 (in that order); and does not return entry #4 from TABLE 3, even though entry #4 has a higher importance score (96) than the importance score of entry #1 (87) from TABLE 3. Entry #4 has been filtered out as being a distance (0 words) less than the third threshold distance (1 word). As in the example of FIG. **5**, "similar products" through links **535** (accesses entries #1 and #4).

Other Example Embodiments

Consider as further description of embodiments of the technology, embodiments that can reduce the number of near-duplicate results from the same company in an online shopping system using a parallel processing indexing pipeline. Each entry in a data store of such a system can include the following attributes: name (product title that appear in the search result page), model (model of the product), description (description of product, will be used to generate snippet for product result), and thumbnail key (a finger print key for the product thumbnail). The parallel processing architecture can present a Map Reduce framework.

In a Map Reduce framework, a Map( ) procedure can perform filtering and sorting (for example sorting products by country of manufacturing into queues, one queue for each country) and a Reduce( ) procedure that can perform a summary operation (such as counting the number of products manufactured in each country). Such a framework can allocate distributed computing devices, running the various tasks in parallel, managing communications and data transfers between the various computing devices, providing for redundancy and failures, and management of the computing process.

In a mapper, the technology can iterate the data store, and for each valid product, output the above attributes and the q-score of the product. The q-score can be a static, query-independent importance score of a product. The output key can be the company identifier of the product. After shuffling, the products with the same company identifier can be gathered in the same reducer. In the reducer, the products can be sorted by q-score in descending order and output with the product attributes.

In some embodiment, the pipeline can be operated daily, and the incremental data store change usually may be marginal from day to day. To cull unnecessary computations, such embodiments can update the entries for only those companies whose entries have changed from previous day in the pipeline. To do this, such embodiments can store a fingerprint of the company products for each company in an update. In the next day, such embodiments can check if the company's fingerprint has changed. Only entries for companies whose fingerprint has changed need by processed.

For each group of company products, the technology can compute all pairs of product distance, filter the product pairs/edges with distance exceeding a given threshold, and perform clustering based on the remaining near duplicate product edges. This can involve the following components: near duplicate distance metric, and a clustering algorithm.

For each product pair (P, Q), the neardup score (or distance) of D(P, Q) can be calculated as the weighted sum of the edit distances of P and Q's attributes: D(P, Q)=K_name*ED(P_name, Q_name)+K_model*ED(P_model, Q_model)+K_description*ED(P_description, Q_description)+K_thumb*ED(P_thumb, Q_thumb), where K_* is a constant factor for each attribute, and P_* and Q_* are attributes of P and Q. For example, P_thumb is the thumbnail key of product P_* and K_thumb is the constant for thumbnail key, etc. The function ED can be the normalized Levenshtein distance of two input string A, B: ED=Levenshtein_Distance(A, B)/max(length(A), length(B)).

The value of ED can be within the range of [0, 1]. The constants also can be within the range of [0,1], and sum up to 1.0, so that the value of distance function D(P, Q) is also within the [0, 1] range.

Groups of entries for company products can be input in a Map-Reduce and clusters of near-duplicate products can be determined, where the products in each cluster are considered near-duplicate to each other. For each group of products from the same company, a pair-wise near-duplicate score can be computed. This forms a complete graph of product edges where each edge can be assigned a near-duplicate score. Given a near-duplicate score threshold T, edges whose score exceeds T can be filtered out. For example, for T=0.05, means that pairs of products that are 5% different from each other (or 95% similar to each other) are considered.

The filtered graph is much more sparse and computationally lightweight than the unfiltered graph. To find the clustering from the near-duplicate graph for each company, a graph traversal can be performed on the filtered graph to find all connected components as the final near-duplicate clusters.

From the clustering result, three (3) near-duplicate fields for each product can be added to each entry: ProductNeardupInfo {cluster_id, min_score, num_products}. Cluster_id can be a unique identifier for a near-duplicate cluster. Each product in the cluster can be assigned the same identifier. In some embodiments the identifier can be set to an attribute of the first product (one with the highest q-score) in the cluster as cluster_id.

This identifier can be useful in two ways. First, in a buyer frontend, an online shopping system can show products in the same cluster by restricting search result with the given cluster_id. Second, typical search infrastructures support crowding by a given field. With cluster_id indexed, the online shopping system can crowd the search result by cluster_id and limit a maximum number of products per cluster. This can have the effect of showing only the most relevant products per near-duplicate cluster in the search result, increasing search diversity.

Min_score can be the closest distance an entry it is to some other entry in the same cluster. This score can be useful in determining how changing the near-duplicate threshold T may affect the near-duplicate filtering in the search result. At a buyer frontend, a search restrict can be set for the threshold T to filter out product results having a min_score at or lower than T. For example, setting T=0 means omitting entries that are identical to some other entry. Setting T=0.01 means omitting products that are no more than 1% different from some other products in the same company.

Num_products can indicate the number of products in the same cluster. This can be used in buyer frontend user interface to show how many products fall into the same cluster.

The data store can be indexed by cluster_id and min_score for each product. In buyer frontend, two search restricts on these fields can be used. First, NDCL can be a search restrict on the cluster_id field of each product. This is a parameter in the search uniform resource locator (URL) to limit the result to only include products in the same cluster. Second, NDTH can be a search restrict on the min_score field of each product. This can be a parameter in the search URL to limit the result to only include products with higher min_score. For example,

NDTH=0.05 can be added to the search URL to filter out near-duplicate products (no more than 5% different from other products).

In the user interface, a link can be shown beside each search result "See all <numproducts> similar products". The link can direct to a new search result page showing all the products in the same near-duplicate cluster. For example, if a result product belongs to the cluster with cluster_id="123", the link can contain the parameter "NDCL=123".

In some embodiments of the technology, product near duplicate information computation can be parallelized in a different fashion than described elsewhere herein, by introducing an additional Map-Reduce to unroll the loop to compute near-duplicate scores for all product pairs and dumping an intermediate product edge store. The output of this Map-Reduce is the set of all product edges, e.g. (P_id, Q_id, C_id) for every products P and Q in company C. The product edges can then be evenly distributed so as to achieve better load-balance in the subsequent Map-Reduce to processes these product edges.

In the Map-Reduce used to processes all the product edges, the product edges (P_id, Q_id, C_id) can be processes and a ProductNeardupInfo can be output for Q, which is keyed by C_id. Two optimizations can be applied in the mapper.

First, since near-duplicate edges with min_score <=T are of concern, and the bottleneck of near duplicate score function D(P, Q) is the edit distance of product description, for each edge (P, Q), the technology can determine: D'(P, Q)=K_name*ED(P_name, Q_name)+K_model*ED (P_model, Q_model)+K_thumb*ED(P_thumb, Q_thumb). If D'(P, Q) is greater than threshold T, the technology does not have to compute ED(P_description, Q_description). Second, by the same reasoning, the edges with min_score>T in the mapper output can be discarded.

In the reducer, all products can be grouped by company and clustering can be performed on the company products. This parallelization can make the time complexity of computing product edges not depend on the biggest company, but can be shared evenly among MR mappers.

For some companies in the data store of the online shopping system, there can be over 30,000 entries. In theory, there could be ~1 B near duplicate edges for such a company, in which case it may be prohibitive to store the graph in memory in full. In some embodiments a streaming version of union-find algorithm can be used to build the disjoint clusters. In lieu of building a near-duplicate graph, the clusters can be built on the fly while the edges are read in the reducer. The algorithm is as follows:

```
BUILD-CLUSTERS:
for edge (P, Q) in stream:
 UNION(P_cluster, Q_cluster)
for P in company:
 P_cluster = FIND(P_cluster)
FIND(P):
 if P_cluster != P_id:
   P_cluster = FIND(P_cluster)
 return P_cluster
UNION(P, Q):
 PP = FIND(P_cluster)
 QP = FIND(Q_cluster)
 PP_cluster = QP_cluster
```

The memory cost in BUILD-CLUSTERS doesn't depends on the entire graph, for example O(N^2), but on the number of products O(N).

Further, since some embodiments of the technology described herein filter out near-duplicate products entries and only keep one product within each cluster in the search result, search quality/coverage could be lost if the near-duplicate entries contain more index information. In particular, product category can be indexed. For example, if near-duplicate entries for products A, B, C with similar title, model, description, thumbnail but with entirely different product categories are in the data store, and only product A is marked in the data store to be not near-duplicate, for some queries that would trigger B or C but not A, or trigger them with higher rank than A could lose search coverage/quality. To address this, in some embodiments the technology can merge the category for all near-duplicate products in a cluster. For the above example, the categories of all A, B and C, can be unioned, and then reset as the category union. This way for each near-duplicate cluster, all product categories will be indexed for all the products.

FIG. **9** depicts a computing machine **2000** and a module **2050** in accordance with certain example embodiments. The computing machine **2000** may correspond to any of the various computers, servers, mobile devices, embedded systems, or computing systems presented herein. The module **2050** may comprise one or more hardware or software elements configured to facilitate the computing machine **2000** in performing the various methods and processing functions presented herein. The computing machine **2000** may include various internal or attached components, for example, a processor **2010**, system bus **2020**, system memory **2030**, storage media **2040**, input/output interface **2060**, and a network interface **2070** for communicating with a network **2080**.

The computing machine **2000** may be implemented as a conventional computer system, an embedded controller, a laptop, a server, a mobile device, a smartphone, a set-top box, a kiosk, a vehicular information system, one more processors associated with a television, a customized machine, any other hardware platform, or any combination or multiplicity thereof. The computing machine **2000** may be a distributed system configured to function using multiple computing machines interconnected via a data network or bus system.

The processor **2010** may be configured to execute code or instructions to perform the operations and functionality described herein, manage request flow and address mappings, and to perform calculations and generate commands. The processor **2010** may be configured to monitor and control the operation of the components in the computing machine **2000**. The processor **2010** may be a general purpose processor, a processor core, a multiprocessor, a reconfigurable processor, a microcontroller, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a graphics processing unit (GPU), a field programmable gate array (FPGA), a programmable logic device (PLD), a controller, a state machine, gated logic, discrete hardware components, any other processing unit, or any combination or multiplicity thereof. The processor **2010** may be a single processing unit, multiple processing units, a single processing core, multiple processing cores, special purpose processing cores, co-processors, or any combination thereof. According to certain embodiments, the processor **2010** along with other components of the computing machine **2000** may be a virtualized computing machine executing within one or more other computing machines.

The system memory **2030** may include non-volatile memories, for example, read-only memory (ROM), programmable read-only memory (PROM), erasable programmable read-only memory (EPROM), flash memory, or any other device capable of storing program instructions or data with or without applied power. The system memory **2030** may also include volatile memories, for example, random access memory (RAM), static random access memory (SRAM),

dynamic random access memory (DRAM), and synchronous dynamic random access memory (SDRAM). Other types of RAM also may be used to implement the system memory **2030**. The system memory **2030** may be implemented using a single memory module or multiple memory modules. While the system memory **2030** is depicted as being part of the computing machine **2000**, one skilled in the art will recognize that the system memory **2030** may be separate from the computing machine **2000** without departing from the scope of the subject technology. It should also be appreciated that the system memory **2030** may include, or operate in conjunction with, a non-volatile storage device, for example, the storage media **2040**.

The storage media **2040** may include a hard disk, a floppy disk, a compact disc read only memory (CD-ROM), a digital versatile disc (DVD), a Blu-ray disc, a magnetic tape, a flash memory, other non-volatile memory device, a solid sate drive (SSD), any magnetic storage device, any optical storage device, any electrical storage device, any semiconductor storage device, any physical-based storage device, any other data storage device, or any combination or multiplicity thereof. The storage media **2040** may store one or more operating systems, application programs and program modules, for example, module **2050**, data, or any other information. The storage media **2040** may be part of, or connected to, the computing machine **2000**. The storage media **2040** may also be part of one or more other computing machines that are in communication with the computing machine **2000**, for example, servers, database servers, cloud storage, network attached storage, and so forth.

The module **2050** may comprise one or more hardware or software elements configured to facilitate the computing machine **2000** with performing the various methods and processing functions presented herein. The module **2050** may include one or more sequences of instructions stored as software or firmware in association with the system memory **2030**, the storage media **2040**, or both. The storage media **2040** may therefore represent examples of machine or computer readable media on which instructions or code may be stored for execution by the processor **2010**. Machine or computer readable media may generally refer to any medium or media used to provide instructions to the processor **2010**. Such machine or computer readable media associated with the module **2050** may comprise a computer software product. It should be appreciated that a computer software product comprising the module **2050** may also be associated with one or more processes or methods for delivering the module **2050** to the computing machine **2000** via the network **2080**, any signal-bearing medium, or any other communication or delivery technology. The module **2050** may also comprise hardware circuits or information for configuring hardware circuits, for example, microcode or configuration information for an FPGA or other PLD.

The input/output (I/O) interface **2060** may be configured to couple to one or more external devices, to receive data from the one or more external devices, and to send data to the one or more external devices. Such external devices along with the various internal devices may also be known as peripheral devices. The I/O interface **2060** may include both electrical and physical connections for operably coupling the various peripheral devices to the computing machine **2000** or the processor **2010**. The I/O interface **2060** may be configured to communicate data, addresses, and control signals between the peripheral devices, the computing machine **2000**, or the processor **2010**. The I/O interface **2060** may be configured to implement any standard interface, for example, small computer system interface (SCSI), serial-attached SCSI (SAS), fiber channel, peripheral component interconnect (PCI), PCI express (PCIe), serial bus, parallel bus, advanced technology attached (ATA), serial ATA (SATA), universal serial bus (USB), Thunderbolt, FireWire, various video buses, and the like. The I/O interface **2060** may be configured to implement only one interface or bus technology. Alternatively, the I/O interface **2060** may be configured to implement multiple interfaces or bus technologies. The I/O interface **2060** may be configured as part of, all of, or to operate in conjunction with, the system bus **2020**. The I/O interface **2060** may include one or more buffers for buffering transmissions between one or more external devices, internal devices, the computing machine **2000**, or the processor **2010**.

The I/O interface **2060** may couple the computing machine **2000** to various input devices including mice, touch-screens, scanners, electronic digitizers, sensors, receivers, touchpads, trackballs, cameras, microphones, keyboards, any other pointing devices, or any combinations thereof. The I/O interface **2060** may couple the computing machine **2000** to various output devices including video displays, speakers, printers, projectors, tactile feedback devices, automation control, robotic components, actuators, motors, fans, solenoids, valves, pumps, transmitters, signal emitters, lights, and so forth.

The computing machine **2000** may operate in a networked environment using logical connections through the network interface **2070** to one or more other systems or computing machines across the network **2080**. The network **2080** may include wide area networks (WAN), local area networks (LAN), intranets, the Internet, wireless access networks, wired networks, mobile networks, telephone networks, optical networks, or combinations thereof. The network **2080** may be packet switched, circuit switched, of any topology, and may use any communication protocol. Communication links within the network **2080** may involve various digital or an analog communication media, for example, fiber optic cables, free-space optics, waveguides, electrical conductors, wireless links, antennas, radio-frequency communications, and so forth.

The processor **2010** may be connected to the other elements of the computing machine **2000** or the various peripherals discussed herein through the system bus **2020**. It should be appreciated that the system bus **2020** may be within the processor **2010**, outside the processor **2010**, or both. According to some embodiments, any of the processor **2010**, the other elements of the computing machine **2000**, or the various peripherals discussed herein may be integrated into a single device, for example, a system on chip (SOC), system on package (SOP), or ASIC device.

In situations in which the technology discussed here collects personal information about users, or may make use of personal information, the users may be provided with a opportunity to control whether programs or features collect user information (e.g., information about a user's social network, social actions or activities, profession, a user's preferences, or a user's current location), or to control whether and/or how to receive content from the content server that may be more relevant to the user. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (, for example, to a city, ZIP code, or state level), so that a particular location of a user cannot be

determined. Thus, the user may have control over how information is collected about the user and used by a content server.

Embodiments may comprise a computer program that embodies the functions described and illustrated herein, wherein the computer program is implemented in a computer system that comprises instructions stored in a machine-readable medium and a processor that executes the instructions. However, it should be apparent that there could be many different ways of implementing embodiments in computer programming, and the embodiments should not be construed as limited to any one set of computer program instructions. Further, a skilled programmer would be able to write such a computer program to implement an embodiment of the disclosed embodiments based on the appended flow charts and associated description in the application text. Therefore, disclosure of a particular set of program code instructions is not considered necessary for an adequate understanding of how to make and use embodiments. Further, those skilled in the art will appreciate that one or more aspects of embodiments described herein may be performed by hardware, software, or a combination thereof, as may be embodied in one or more computing systems. Moreover, any reference to an act being performed by a computer should not be construed as being performed by a single computer as more than one computer may perform the act.

The example embodiments described herein can be used with computer hardware and software that perform the methods and processing functions described previously. The systems, methods, and procedures described herein can be embodied in a programmable computer, computer-executable software, or digital circuitry. The software can be stored on computer-readable media. For example, computer-readable media can include a floppy disk, RAM, ROM, hard disk, removable media, flash memory, memory stick, optical media, magneto-optical media, CD-ROM, etc. Digital circuitry can include integrated circuits, gate arrays, building block logic, field programmable gate arrays (FPGA), etc.

The example systems, methods, and acts described in the embodiments presented previously are illustrative, and, in alternative embodiments, certain acts can be performed in a different order, in parallel with one another, omitted entirely, and/or combined between different example embodiments, and/or certain additional acts can be performed, without departing from the scope and spirit of various embodiments. Accordingly, such alternative embodiments are included in the technology described herein.

Although specific embodiments have been described above in detail, the description is merely for purposes of illustration. It should be appreciated, therefore, that many aspects described above are not intended as required or essential elements unless explicitly stated otherwise. Modifications of, and equivalent components or acts corresponding to, the disclosed aspects of the example embodiments, in addition to those described above, can be made by a person of ordinary skill in the art, having the benefit of the present disclosure, without departing from the spirit and scope of embodiments defined in the following claims, the scope of which is to be accorded the broadest interpretation so as to encompass such modifications and equivalent structures.

We claim:

1. A computer-implemented method to reduce same merchant near-duplicate entries in online shopping system search results, comprising:

for each pair of entries in a set of entries from the same merchant, each entry characterizing a product in a data store of an online shopping system and each entry characterized by a set of quantified attributes, determining, by one or more computing devices, a distance between the entries in the pair in a vector space of the quantified attributes;

determining, by the one or more computing devices, clusters of entries as a function of the determined distance between each pair of entries;

receiving, by the one or more computing devices, a query directed to the data store; and

returning, by the one or more computing devices, an ordered list of results responsive to the query from the data store of an online shopping system, filtered as a function of the determined distance to reduce the number of near duplicate entries from the same entry in the search results, wherein filtering as a function of the determined distance comprises at least one of:

limiting the number of entries from a given cluster to a predetermined threshold number of entries from the given cluster; and

after including in the ordered list a first entry from a given cluster of entries, excluding entries within a predetermined first threshold distance of the first entry.

2. The method of claim **1**, wherein determining a distance between the entries in the pair based on the quantified attributes comprises determining a weighted sum of an edit distance between the quantified attributes of entries of the pair.

3. The method of claim **2**, wherein the edit distance is one of: a Hamming distance, a Levenshtein distance, a Damerau-Levenshtein distance, and a Jaro-Winkler distance.

4. The method of claim **1**, wherein determining clusters of entries comprises identifying as clusters groups of entries related to another entry by a determined distance of less than a predetermined first second threshold distance.

5. The method of claim **4**, wherein the distance is normalized on an interval from 0 to 1, and the predetermined second threshold distance is approximately 0.05.

6. The method of claim **1**, further comprising:

for at least one result in the ordered list, returning, by the one or more computing devices, a link: which, when selected, prompts as a response from the online shopping system an ordered list of products in the same cluster as the at least one result.

7. A computer program product, comprising:

a non-transitory computer-readable storage device having computer-executable program instructions embodied thereon that when executed by a computer cause the computer to reduce same merchant near-duplicate entries in online shopping system search results, the computer-executable program instructions comprising:

computer-executable program instructions to determine, for each pair of entries from the same merchant in a set of entries, each entry characterizing a product in a data store of an online shopping system and each entry characterized by a set of quantified attributes, a distance between the entries in the pair in a vector space of the quantified attributes;

computer-executable program instructions to determine clusters of entries from a graph formed with each determined distance as an edge between nodes representing the entries used to determine the corresponding distance, each entry cluster identified by a cluster identifier;

computer-executable program instructions to receive a query directed to the data store; and

computer-executable program instructions to return an ordered list of results responsive to the query from the data store of an online shopping system, filtered as a function of the determined distance to reduce the number of near duplicate entries from the same entry in the search results, wherein filtering as a function of the determined distance comprises at least one of:

limiting the number of entries from a given cluster to a predetermined threshold number of entries from the given cluster; and

after including in the ordered list a first entry from a given cluster of entries, excluding entries within a predetermined first threshold distance of the first entry.

8. The computer program product of claim **7**, wherein determining a distance between the entries in the pair based on the quantified attributes comprises determining a weighted sum of an edit distance between the quantified attributes of entries of the pair.

9. The computer program product of claim **8**, wherein the edit distance is one of: a Hamming distance, a Levenshtein distance, a Damerau-Levenshtein distance, and a Jaro-Winkler distance.

10. The computer program product of claim **7**, wherein determining clusters of entries comprises identifying as clusters groups of entries related to another entry by a determined distance of less than a predetermined second threshold distance.

11. The computer program product of claim **10**, wherein the distance is normalized on an interval from 0 to 1, and the predetermined second threshold distance is approximately 0.05.

12. The computer program product of claim **7**, further comprising:

for at least one result in the ordered list, returning, by the one or more computing devices, a link: which, when selected, prompts as a response from the online shopping system an ordered list of products in the same cluster as the at least one result.

13. A system to reduce same merchant near-duplicate entries in online shopping system search results, comprising:

a storage device; and

a processor communicatively coupled to the storage device, wherein the processor executes application code instructions that are stored in the storage device to cause the system to:

determine, for each pair of entries in a set of entries from the same merchant, each entry characterizing a product in a data store of an online shopping system and each entry characterized by a set of quantified attributes, a distance between the entries in the pair in a vector space of the quantified attributes;

determine clusters of entries from a graph formed with each determined distance as an edge between nodes representing the entries used to determine the corresponding distance, each entry cluster identified by a cluster identifier;

receive a query directed to the data store; and

return an ordered list of results responsive to the query from the data store of an online shopping system, filtered as a function of the determined distance to reduce the number of near duplicate entries from the same entry in the search results, wherein filtering as a function of the determined distance comprises at least one of:

limiting the number of entries from a given cluster to a predetermined threshold number of entries from the given cluster; and

after including in the ordered list a first entry from a given cluster of entries, excluding entries within a predetermined first threshold distance of the first entry.

14. The computer program product of claim **13**, wherein determining a distance between the entries in the pair based on the quantified attributes comprises determining a weighted sum of an edit distance between the quantified attributes of entries of the pair.

15. The system of claim **14**, wherein the edit distance is one of: a Hamming distance, a Levenshtein distance, a Damerau-Levenshtein distance, and a Jaro-Winkler distance.

16. The system of claim **13**, wherein determining clusters of entries comprises identifying as clusters groups of entries related to another entry by a determined distance of less than a predetermined second threshold distance.

17. The system of claim **16**, wherein the distance is normalized on an interval from 0 to 1, and the predetermined second threshold distance is approximately 0.05.

18. The system of claim **13**, further comprising:

for at least one result in the ordered list, returning, by one or more computing devices, a link which, when selected, prompts as a response from the online shopping system an ordered list of products in the same cluster as the at least one result.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 9,342,849 B2
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INVENTOR(S)	: Liang Hu et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims:

Claim 4, Column 14, Line 36 should read "--a predetermined second threshold distance.--"

Signed and Sealed this
Twentieth Day of September, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office